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STATE OF ALASKA

William A. Egan, Governor

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FEDERAL AID IN FISH RESTORATION PROJECT F-5-R-5

SPORT FISH INVESTIGATIONS OF ALASKA

ALASKA DEPARTMENT OF FISH AND GAME
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INTRODUCTION

This report of progress consists of Job Segment Reports from the State of Alaska Federal Aid in Fish Restoration Project F-5-R-5, "Sport Fish Investigations of Alaska."

The project is composed of 25 separate studies designed to evaluate the various aspects of the State's recreational fishery resources. Of these, eight jobs are designed to continue the cataloging and inventory of the numerous State waters in an attempt to prepare an index of the recreational waters. Four jobs are designed for specific sport fishery creel census while the remainder of the jobs are more specific in nature. These include independent studies on king salmon, silver salmon, grayling, Dolly Varden, a statewide access evaluation program, egg take program and a residual toxaphene study. The information gathered from the combined studies will provide the necessary background data for a better understanding of local management problems and assist in the development of future investigational studies.

The subject matter contained within these reports is often fragmentary in nature. The findings may not be conclusive and the interpretations contained therein are subject to re-evaluation as the work progresses.

Volume 5 Report No. 10-E-1

JOB COMPLETION REPORT

RESEARCH PROJECT SEGMENT

STATE: ALASKA Name: Sport Fish Investigations of Alaska.

Project No: F-5-R-5 Title: Investigations of Residual Toxaphene Effects in Six Matanuska Valley Lakes.

Job No: 10-E-1

Period Covered: January 1, 1963 to December 31, 1963.

Abstract:

Study of the six lakes between Palmer and Willow rehabilitated in 1961 was continued in 1963 in an attempt to evaluate the effects of the toxicant.

Hatchery rainbow trout planted in Finger Lake in the fall of 1962 showed excellent survival and growth. A native population of residual silver salmon which re-inhabited Willow Lake in the summer of 1962 survived and exhibited normal growth.

Live-car tests continued in the remaining four lakes. Mortality of test fish was greater during series one than during series two introductions due to low vitality. Last survivors from the live-cars, sample fish netted from Finger and Willow Lakes, and water samples from each study lake were sent to a professional laboratory for residual toxaphene analysis.

Collection of adequate invertebrate insect and plankton samples was not possible due to extended soft, spring access road conditions. Unavailability of sampling equipment precluded mud sample collections.

Toxaphene content in fish flesh at Finger and Willow Lakes rose during winter and decreased rapidly during the summer season. Higher concentrations of residual toxicity remain in fish flesh than in water and mud samples.

Following study of analyses and live-car findings, all study waters were considered suitably clear for game fish except Florence Lake, which remained questionable. Experimental game fish introductions were made in late summer to the four barren test waters, and a second plant was added to Finger Lake. Willow Lake was not stocked.

Recommendations:

It is recommended that experimental gill nets be used at each study lake in spring to capture trout from the 1963 hatchery plant for survival, growth and residual toxaphene evaluations.

Live-car studies should be re-initiated in any lake which fails to produce surviving fish.

Aquatic insect, mollusk and plankton samples should be analyzed. They are the most likely reasons for the existing residual toxin content in fish flesh.

Samples for aquatic insect and plankton progression evaluation should be collected once during the 1964 season, as close as possible to the collection date of 1962.

It is recommended that all test waters except Willow Lake be replanted if they prove suitably clear in 1964.

A final recommendation is that Willow Lake not be planted. An evaluation study would be complicated by competition with native stickleback and silver salmon, plus marginal winter oxygen levels in this shallow lake.

Objectives:

To determine the existence and distribution of residual toxaphene in six of the Matanuska Valley Lakes rehabilitated in 1961.

To determine the toxicity of these lakes in relation to game fishes.

To determine the time these lakes become suitable habitat for game fishes.

To provide recommendations for future studies and management of these and similar lakes.

Techniques Used:

Live-cars and experimental gill nets were employed for collection of fish samples from the six test lakes for continual residual toxaphene analysis. Unusually wet road conditions prevented access to three of the four lakes slated for continued live-car study until July 10, when two units were placed in each of the following waters:

Bumblebee Lake	Loon Lake
Crystal Lake	Nancy Lake (control)
Florence Lake	

Placement of units in Loon and Nancy Lakes, which were accessible prior to July 10, was suspended until all units could be introduced for purposes of uniformity and comparison.

Prior to placement, the location for each live-car was tested to assure that suitable dissolved oxygen and temperature conditions existed. One live-car was placed below the thermoclines in each of Bumblebee and Florence Lakes, the two test waters of adequate depth to stratify. Placement depths are recorded in TABLE 1.

Each live-car consisted of a wood frame covered with screen measuring five mesh to an inch, with a hinged, bolted door at one end. Dimensions were 18 x 18 x 30 inches. Past experience proved that smaller mesh screen filled completely with algae.

Tests were run in two series; the first from mid-July to mid-September, the second from mid-September to mid-October. Series one was terminated after eight weeks and series two after four weeks due to developing ice cover. Nancy Lake was used as a control water for comparative survival purposes during both series of tests.

Wild rainbow trout fingerlings three to five inches in length were used for the first introduction. Hatchery fish at that time were frail, and too small to be held by the screen meshes. Hatchery-reared silver salmon averaging two inches in length were utilized for the second test introduction. For testing, 16 fish were placed in each box for series 1, and 20 fish were placed in each box for series 2.

TABLE 1. Mortality Percentages of Live-Car Test Fish in Five Matanuska Valley Lakes from July 10 to September 14, 1963.

Days Tested	TEST LAKES								CONTROL LAKE	
	Bumblebee		Crystal		Florence		Loon		Nancy	
	5 ft.	15 ft.	5 ft.	15 ft.	5 ft.	15 ft.	5 ft.	15 ft.	5 ft.	15 ft.
7	19	31							25	25
11					31	100	6	31		
12			50	50					50	50
16	31	50								
20							13	63		
21			50	75						
29	38	63			44				63	56
33							13	75		
34			100	75						
39									100	69
40	38	100								
42					63*					
48										75
52	Car missing			100						
60										100
64							19*	75		

*Survivors removed for residual toxaphene analysis.

The existence of resident game fish populations in the two remaining study waters, Finger and Willow Lakes, precluded the necessity of live-car introductions. Experimental gill nets, 100 feet in length with five 20-foot panels in 1/2, 3/4, 1, 1-1/4 and 1-1/2 inch bar measure increments, were used to make collections. Locations of the six study waters and the control lake are shown in FIGURE 1.

The last live-car survivors from Florence and Loon Lakes were removed September 14, quick-frozen and sent to the food, Chemical and Research Laboratory at Seattle for residual toxaphene analysis. Wet road conditions hampered periodic observation of the series one test units to the extent that all fish expired in Crystal Lake, and beavers severed the buoy lines in Bumblebee Lake before surviving fish could be extracted for analysis. Survivors of the second test series were removed from Bumblebee and Crystal Lakes for analysis on October 18.

Planted rainbow were netted March 1, May 17 and September 12 at Finger Lake, and native silver salmon were netted June 8 and September 12 at Willow Lake for evaluation. Depending on size, two to five captured fish constituted an adequate sample mass from each lake.

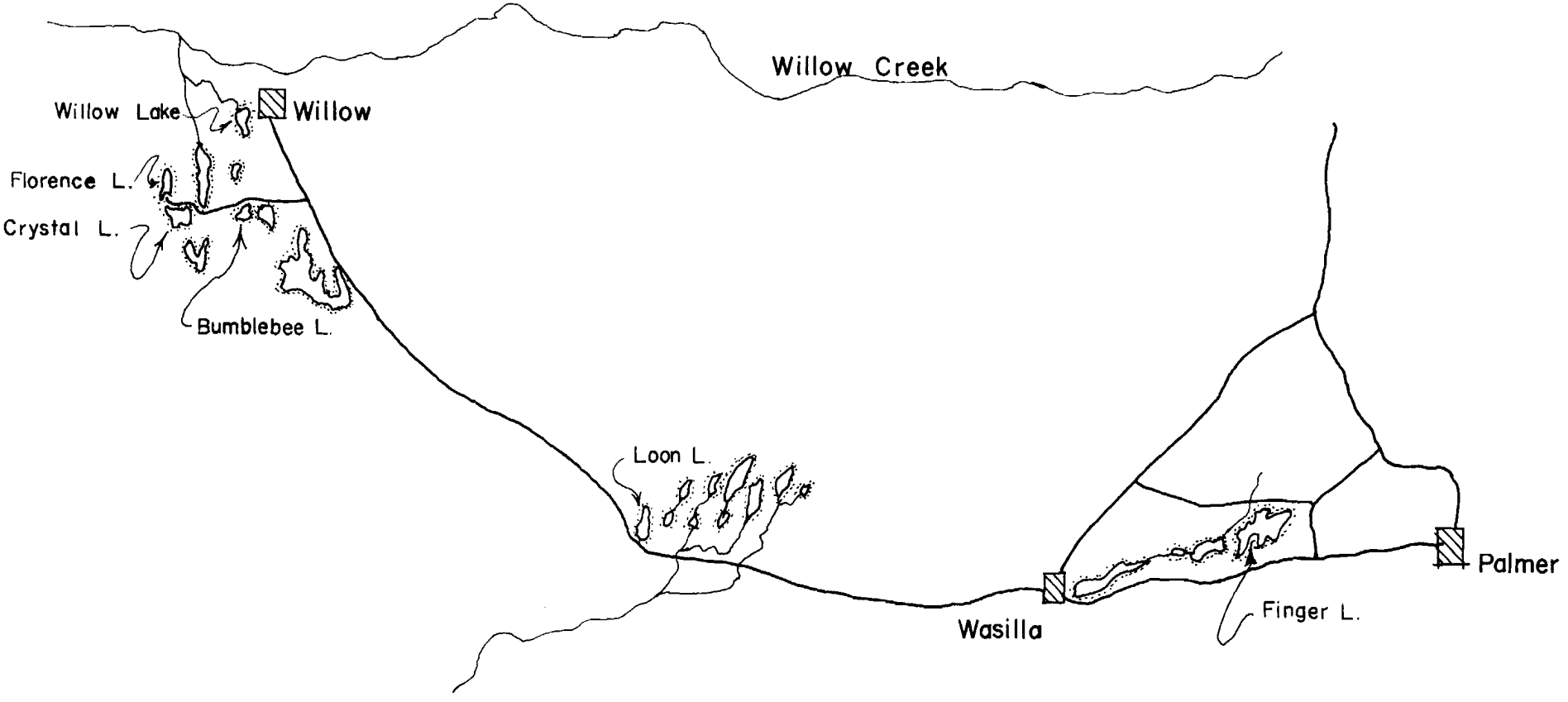
For analysis, 1-gallon water samples were collected from the 5, 20 and 35-foot levels of Finger Lake during the spring over-turn period in May. Other test waters were inaccessible due to road conditions. A 1-gallon water sample was taken from the 5-foot level of each test lake during the fall over-turn period in October for analysis.

Collection of invertebrate insect and plankton samples for succession counts and residual toxin analyses was suspended as difficult road conditions prevented simultaneous collections at the proper time for comparison with 1962 data. Mud samples were not taken from Bumblebee and Crystal Lakes as planned due to unavailability of an Ekman Dredge. At attempt to extract adequate samples using a weighted can proved unsuccessful.

Findings:

Spring and summer test net studies at Finger and Willow Lakes disclosed that successful over-winter survival was achieved. Hatchery rainbow introduced into Finger Lake in September of 1962 showed excellent survival and growth. Planted at a density of 91 per surface acre, fish entered 3 sinker gill nets at a rate of 3.1 per night

Figure I. Location of Matanuska Valley toxaphene-treated lakes.



hour August 21, Average length was 12.8 inches. A native population of silver salmon which voluntarily re-entered Willow Lake in summer of 1962 was captured in 3 sinker nets at a rate of 0.33 per night hour August 24. These fish averaged 10.7 inches in length.

Live-car test fish mortality proceeded more rapidly during series one than during series two tests. Although survival compared favorably with that of the control, Nancy Lake (TABLE 1) mortality during series one exceeded 80 per cent over the first 3-week period, necessitating the second introduction. Vitality of the test fish was probably low at the early introduction date. Although oxygen and temperature levels were adequate, all fish in the Florence Lake deep set died within 11 days after introduction. They were retrieved in a decomposed condition. Numerous stickleback were found in the live-cars at Crystal Lake, showing that reinfestation had occurred via the intermittent outlet to Long Lake.

Series two fish were removed October 18, when ice began to form on some of the lakes. The sole mortality occurred at Florence Lake. After 23 days, all fish were dead in the 35-foot live-car. At the time of test termination, three fish had died in the 5-foot unit.

Results of fish flesh analysis indicated that the waters lowest in toxicity were Bumblebee, Crystal, Finger and Willow Lakes, all containing concentrations of 100 parts per billion (TABLE 2). Florence Lake contained the highest concentration. Loon Lake failed to follow the toxicity pattern of the other test waters. In the climb from 400 to 500 parts per billion, it exceeded the apparent flesh content of 1963 Crystal and Bumblebee Lake samples. Since test fish mortality in TABLE 1 indicates better survival than at any other test water or the control lake, it is possible that an error in the analysis procedure for Loon Lake may have occurred. A comparison of toxaphene content of fish flesh in the test lakes in late summer of 1962 and 1963 follows:

Toxaphene Content of Fish Flesh in Parts Per Billion

Lake	1962	1963
Willow	81	100
Finger	None detected, less than 0.5 ppb	100
Loon	400	500
Crystal	500	100
Bumblebee	1,400	100
Florence	1,000	600

TABLE 2. Results of Residual Toxaphene Content Analysis of Fish and Water Samples, 1963

Lake	Sample Type	Sampling Date	Sample Size	Sample Depth		Toxaphene ppb*
Bumblebee	fish	10/18				100
	water	10/22	1 gal.	5 ft.	none detected, less than	0.5
Crystal	fish	10/18				100
	water	10/22	1 gal.	5 ft.	none detected, less than	0.5
Finger	fish	3/1				1,500
	fish	5/17				1,600
	fish	9/12				100
	water	5/15	1 gal.	5 ft.	none detected, less than	0.5
		5/15	1 gal	20 ft.	none detected, less than	0.5
		5/15	1 gal.	35 ft.	none detected, less than	0.5
		10/22	1 gal.	5 ft.	none detected, less than	0.5
Florence	fish	9/14				600
	water	10/22	1 gal.	5 ft.	none detected, less than	0.5
Loon	fish	9/14				500
	water	10/22	1 gal.	5 ft.	none detected, less than	0.5
Willow	fish	6/18				200
	fish	9/12				100
	water	10/22	1 gal.	5 ft.	none detected, less than	0.5

*Parts per billion

The Table indicates progressive detoxication of the last three waters in 1963. No significant change is apparent at Finger and Willow Lakes, the two waters considered sufficiently clear for fish introduction in 1962.

A more complete picture of the toxicity fluctuations at Finger and Willow Lakes, shown in FIGURE 2, points up the limitations of live-car procedures in evaluating the status of waters treated with accumulative poisons. The 1962 analyses were performed on live-car fish. The 1963 sample fish, taken by test net, had resided in and had been subject to toxaphene effects in excess of a year. A buildup of toxin until the end of the spring over-turn period was followed by a reduction during the summer season. Between June 18 and September 12, the mass of the fish samples at Willow Lake increased approximately 4.4 times, while the flesh content toxicity decreased by 50 per cent. Fish mass increased approximately 6.8 times at Finger Lake while flesh content toxicity decreased 93.7 per cent between May 17 and September 12.

Relative toxicity of fish flesh appears to be a function of maximum depth and percentage of water volume below plant production levels. TABLE 3 compares physical characteristics, residual toxin contents and test-fish mortalities at the six lakes. Finger Lake is not the exception it would seem. The two deep areas of small size and the extensive, undulating shoreline result in a small percentage of water volume below the plant production level. The other lakes involved fall into the characteristic bowl shape category.

A higher concentration of toxaphene presently exists in the fish flesh than in the mud and water media, with one exception. Mud sample concentrations were below 50 parts per billion in 1962, except Bumblebee Lake, which contained 150 parts per billion. No measurable residue remained in the water of any test lake in 1963.

A thorough study of live-car mortality patterns and past analyses resulted in a decision to introduce rainbow trout experimentally to the four barren test waters. These waters were considered sufficiently clear for game fish survival, except Florence Lake, the status of which remained uncertain. The waters and densities of planting follow:

Lake	Fish/Acre	Total Fish
Bumblebee	60	5,000
Crystal	77	10,000
Florence	110	8,000
Loon	88	10,160

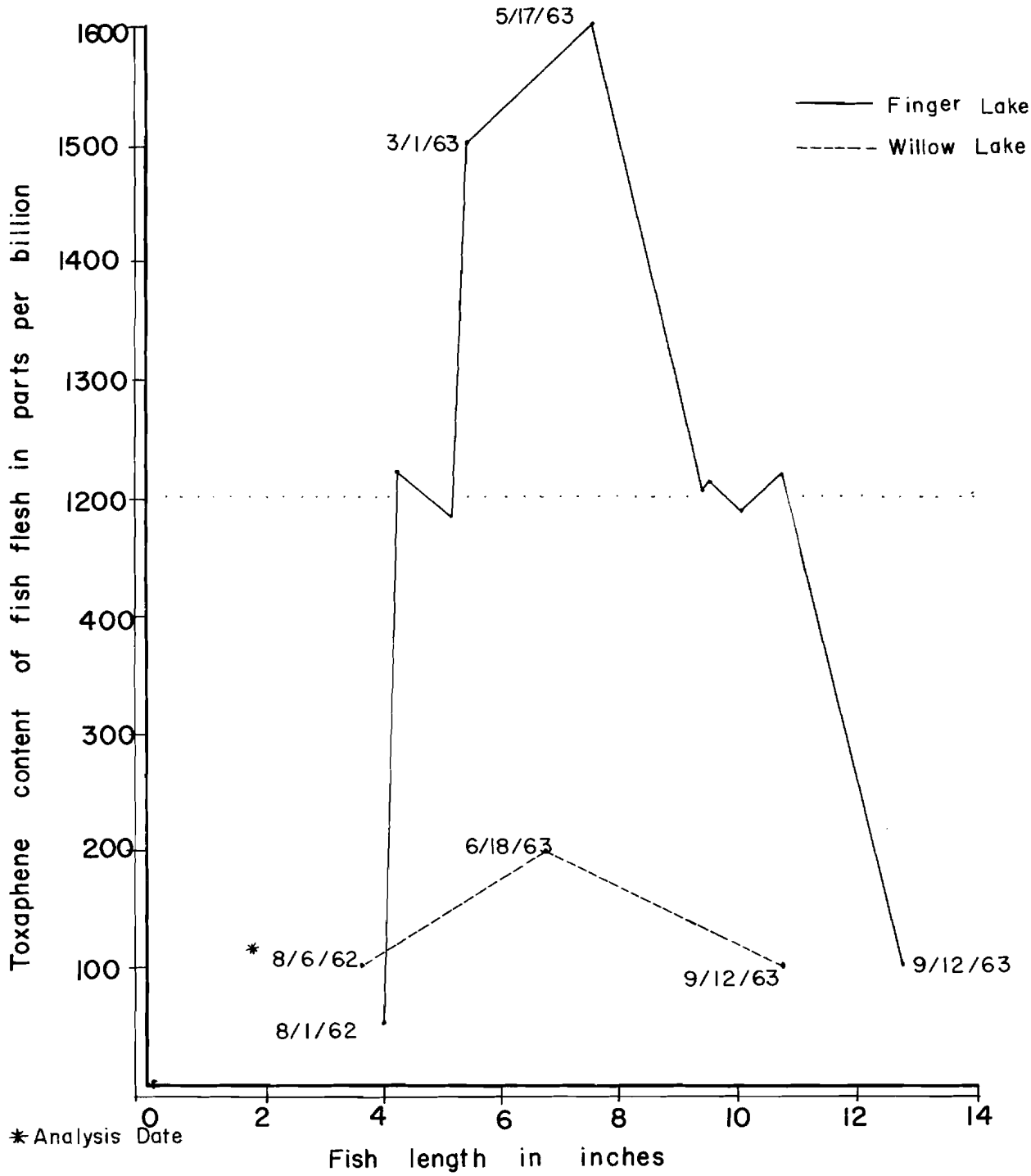


Figure 2. Toxaphene concentrations fluctuation in salmonoid fish flesh as compared to body length, Finger and Willow lakes.

TABLE 3. A Comparison of Physical Characteristics, Residual Toxaphene Content and Mortality of Test Fish in Six Treated Lakes, Matanuska Valley, 1963.

Lake	Max. Depth in Feet	Thermocline	Toxaphene Content Analyzed Fish	Test Fish Mortality Series 1 No. Days	Percentage
Willow	11	No	11 ppb*	No units set	
Finger	44	Yes	100 ppb	No units set	
Loon	20	No	500 ppb	64	47
Crystal	25	No	100 ppb	52	100
Bumblebee	37	Yes	100 ppb	40	69
Florence	40	Yes	600 ppb	42	81.5

*Parts per billion

Finger Lake received a second plant of 80,000 hatchery-reared silver salmon under what is now considered a normal annual management program. Willow Lake was not included in the experimental planting program for three reasons: winter dissolved oxygen levels are marginal for game fish; competing native silver salmon and stickleback entered the lake from the outlet to Willow Creek in 1962 and are increasing rapidly; and stocked fish could desert the lake at will via the outlet.

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